IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:		)
		) ATTORNEY FILE NO.:
Inventors:	Moriguchi et al.	) SLA0770
		)
Serial No.:	10/602,266	)
		) Examiner: Padgett,
		) Marianne L.
		)
Filed:	June 23, 2003	) Customer No.: 55,286
		) Confirmation No.: 1706
Title:	GRAIN-FREE POLYCRYSTAL-	)
	LINE SILICON AND METHOD	) Group Art: 1762
	FOR PRODUCING SAME	)

Board of Patent Appeals and Interferences
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

BRIEF ON APPEAL

This is an appeal from the rejection by Examiner Marianne Padgett, Group Art Unit 1792, of claims 1, 3-21, 23, 25-44, and 65-66, as set forth in the CLAIMS APPENDIX.

TABLE OF CONTENTS

REAL PARTY IN INTEREST

The real party in interest is Sharp Laboratories of America, Inc., as assignee of the present application in the United States Patent Office, with a recordation date of June 23, 2003 at Reel 014272, Frame 0222.

RELATED APPEALS AND INTERFERENCES

None.

STATUS OF THE CLAIMS

Claims 2, 22, 24, and 45-64 are canceled.

Claims 1, 3-21, 23, 25-44, and 65-66 are in the application.

Claims 1, 3-21, 23, 25-44, and 65-66 are rejected.

Claims 1, 3-21, 23, 25-44, and 65-66 are appealed.

STATUS OF AMENDMENTS

Amendments to the claims were presented in a paper received at the PTO on May 21, 2008. These claim amendments have been entered.

SUMMARY OF CLAIMED SUBJECT MATTER

The present invention is an improvement over conventional sequential lateral solidification (SLS) laser annealing processes. The SLS process is directional – laterally growing crystal grain boundaries in one direction in a first step, and then laterally growing crystal grain boundaries in an orthogonal direction in a second step. There are two serious problems associated with the SLS process. First, either the substrate or the mask must be orthogonally rotated after each step, which is cumbersome. Second, even after orthogonal annealing, grain boundaries still exist. If a grain boundary exists in a critical region, e.g., a transistor channel region, transistor performance is degraded. The present invention addresses both these problems.

Claim 1 recites a method for producing polycrystalline silicon (specification, page 21, ln. 17 through page 22, ln. 8; see Fig. 14). Step 1403 forms a film of amorphous silicon (page 21, ln. 24). Step 1404 uses a 2N-shot laser irradiation process to form polycrystalline silicon in a first area of the film (page 21, ln. 24-26). In the 2N-shot laser irradiation process the film is exposed to a series of 2-shot laser irradiation steps, where N is greater than 1 and equal to the number of steps (in the series). For each step, the direction of lateral growth in rotated 90° with respect to the previous step. More explicitly, claim 1 recites that in a first step, a laser beam in projected through a first aperture pattern oriented in a first direction with respect to the film. In a second step, the laser beam is projected through a second aperture pattern oriented in a second direction, orthogonal to the first direction. The second step is accomplished without rotating the silicon film and without rotating the

aperture pattern. The paragraph beginning at line 10 of page 6 describes the 2N-shot process in detail.

After performing the 2N-shot process, Step 1416 selects a second area, included in the first area (page 22, ln. 3). Step 1418 uses a directional solidification (DS) process to anneal the second area (page 22, ln. 3-4). An explanation of how the DS process removes grain boundaries inside a selected area can be found on page 11, ln. 8-15.

Claim 65 recites a method for laterally growing crystal grains in predetermined areas of a previously annealed silicon film (page 11, ln. 8-15 and page 22, ln. 1-8, see Fig. 14). Step 1414, in a first area of a silicon film, forms polycrystalline silicon having a plurality of parallel grain boundaries oriented in a first direction, and a plurality of parallel boundaries in a second direction, orthogonal to the first direction (page 22, ln. 1-2). Steps 1416 and 1418 use a DS annealing process to sequentially anneal a second area defined by a pair of grain boundaries in the first direction, intersection a pair of grain boundaries oriented in the second direction. (page 22, ln. 3-4, and page 11, ln. 8-11). Step 1424 laterally grows crystal grains in the second area in response to DS annealing (page 22, ln. 6-8, and page 11, ln. 11-15).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 25-38 and 65-66 are indefinite under 35 U.S.C. 112, second paragraph.

2. Whether claims 65-66 are enabled in the specification, in accordance with 35 U.S.C. 112, first paragraph.

3. Whether claims 25-38 comply with the enablement requirement under 35 U.S.C. 112, first paragraph.

4. Whether claims 1, 3-21, 23, and 25-44 comply with the enablement requirement under 35 U.S.C. 112, first paragraph.

5. Whether 1, 3-21, 23, 25-44, and 65-66 are unpatentable under 35 U.S.C. 103(a) with respect to Sposili et. al. ("Sposili"; US 6,908,835 or WO 02/086954) in view of Yamazaki et al. ("Yamazaki"; US 5,894,137), and Fukunaga et al. ("Fukunaga"; US 2004/0142543) or Kawasaki et al. ("Kawasaki"; US 6,653,657).

ARGUMENT

1. The rejection of claims 25-38 and 65-66 under 35 U.S.C. 112, second paragraph, as being indefinite.

CLAIMS 25, 28, 32, 35

In Section 2 of the Office Action claims 25-38 and 65-66 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite. With respect to claim 25, 28, 32, and 35, the Office Action states that the claim language can be interpreted to read that the annealing is done at some time after the application of the energy densities, or that the annealing is caused by the energy applied by two different lasers. For example, the Office Action (page 3) states that claim 25 can be interpreted to describe concurrent processes, but also suggest "...the possibility that the annealing is done at a later time due to the energy effects caused by the energy effects caused by the first and second laser beam energy densities." The Applicant does not necessarily concur that the first and second energy needed to be concurrently performed, but if the specification describes only processes that are performed concurrently, as suggested by the Examiner, then there is no ambiguity.

"We have held that a claim is not indefinite merely because it poses a difficult issue of claim construction; if the claim is subject to construction, i.e., it is not insolubly ambiguous, it is not invalid for indefiniteness." *Honeywell Int'l, Inc. v. Int'l Trade Comm'n*, 341 F.3d 1332, 1338-39 (Fed. Cir. 2003). That is, if the meaning of the claim is discernible, "even though the task may be formidable and the conclusion may be one over which reasonable persons will disagree, we have held the

claim sufficiently clear to avoid invalidity on indefiniteness grounds." *Exxon Research & Eng'g Co. v. United States,* 265 F.3d 1371, 1375 (Fed. Cir. 2001).

Further, whether a claim is indefinite "depends on whether those skilled in the art would understand the scope of the claim when the claim is read in light of the specification." *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1576 (Fed.Cir.1986). The Applicant respectfully submits that a practitioner in the art would understand that annealing occurs in response to exposure to two energy densities, especially when the claim is read in light of the specification. Claim 25 is not intended to explicitly disclose every possible variable involved in the annealing process.

The Office Action also asserts that claim 25 contradicts the Applicant's response of 1/28/2008. The Applicant's response of 1/28/2008 (page 14) states that claim 25 introduces additional limitations that are performed concurrently with the previously recited step of "using a 2N-shot laser irradiation process..." The limitations introduced in claim 25 are substeps of "using the 2N-shot laser irradiation process". Therefore, the substeps are necessarily concurrent in that they must be performed within the context of the 2N-shot process. However, the Applicant's statement of 1/28/2008 does not explicitly state that the first and second energy densities need be performed concurrently. Further, the word "concurrently" is open to different interpretations. In summary, there is no requirement that claim 25 recite that the first and second energy densities are applied concurrently. This same analysis applied to claims 28, 32, and 35.

CLAIMS 26-27, 29-31, 33-35, AND 36-38

Claims 26-27 have been rejected on the basis that they are dependent from claim 25. Since 25 is not indefinite, claims 26-27 are not indefinite. Claims 29-31 have been rejected on the basis that they are dependent from claim 28. Since 28 is not indefinite, claims 29-31 are not indefinite. Claims 33-35 have been rejected on the basis that they are dependent from claim 32. Since 32 is not indefinite, claims 33-35 are not indefinite. Claims 36-38 have been rejected on the basis that they are dependent from claim 35. Since 35 is not indefinite, claims 236-38 are not indefinite.

CLAIM 65

The Office Action states that the body of the claim is not commensurate with the interpretation of the preamble, and that the claims do not necessitate that the limitation of "laterally growing" occur with respect to "forming polycrystalline silicon…" or "using a DS annealing process". In response, the Applicant notes that the claim recites "in response to DS annealing, laterally growing crystal grains in the second area." This claim language is in accordance with the specification and the Applicant's statement of 5/21/2008 (page 14) that the lateral growth occurs as a result of the DS annealing. The Office Action also states that the limitation of laterally growing crystal grains in response to the DS annealing can also be interpreted to require "…another step to produce lateral growth due to the results of the DS annealing."

The Applicant is unsure of the exact meaning of the above-quoted assertion. Although it is possible that other factors may contribute

to annealing, there is no requirement that every factor be listed in a single claim. The Applicant requests that if the claims require interpretation, that they be interpreted in light of the specification.

CLAIM 66

The Office Action states that grain boundaries recited in claim 66 are not clearly differentiated. Claim 66 recites that crystal grains are grown across grain boundaries previously defined in the second direction. Since claim 66 is dependent from claim 65, and since claim 65 recites a plurality of parallel boundaries oriented in the second direction, the Applicant respectfully submits that a person with skill in the art would understand that claim 66 recites the growth of grains across the (second direction) grain boundaries previously introduced in claim 65.

2. The rejection of claims 65-66 as failing to be enabled in the specification, in accordance with 35 U.S.C. 112, first paragraph.

In Section 4 of the Office Action, claims 65-66 have been rejected under 35 U.S.C. 112, first paragraph, as not being enabled in the specification. The Office Action states that the specification does not enable forming a polycrystalline film from unlimited or unspecified microstructures by techniques other than laser annealing and 2N-shot laser irradiation. The Office Action also states that claim 65 is broader than claim 1.

In response, the Applicant notes that there is no requirement that independent claim 65 be narrower than independent claim 1. The

Office Action states that the original claims do not support the broader scope of claims 65-66. Again, there is no requirement that claims 65 be supported by claim 1. Further, the Office Action states that the specification only describes crystal grain boundaries as resulting from laser annealing processes. Thus, the Examiner acknowledges that the formation of grain boundaries is enabled. Further, since the document is written for one with skill in the art, such a reader would understand such an enablement, even without support in the specification.

In response to the statement in the Office Action that claim 65 recites lateral solidification to form crystal grains during a step other than DS annealing, the Applicant notes that claim 65 explicitly states that crystal grains are laterally grown in response to DS annealing. Claim 65 does not recite an imaginary limitation on laterally growing crystal grains after the performance of the DS annealing. Alternately stated, the claims should be interpreted as broadly as possible, but only within the supporting context of the specification.

CLAIM 66

Claim 66 is dependent from claim 65. Since claim 65 is enabled by the specification, dependent claim 66 is likewise enabled.

3. The rejection of claims 25-38 for failure to comply with the enablement requirement under 35 U.S.C. 112, first paragraph.

CLAIMS 25, 28, 32, and 35

In Section 5 of the Office Action claims 25-38 have been rejected under 35 U.S.C. 112, first paragraph, as failing to comply with

the enablement requirement. The Office Action appears to object to the statement in the specification that some of the steps may be skipped or performed in parallel. The Office Action further states that "...arrows in the figure are considered an explicit statement or order, especially when it is explicitly called a flowchart." The Applicant is unfamiliar with any sections in the MPEP, 37 CFR, or 35 U.S.C. defining a relationship between arrows in a flowchart and order. However, if such a statement is in fact correct, then there is no ambiguity in Fig. 14.

Practically, the Applicant notes that even without specification, the figure depicts an accurate and detailed process flow that describes every variation of the invention. However, not every step in the figure is necessary to support the broadest recitation of the claims. For example, in the broadest explanation of the invention, the specification describes a progression from Step 1404 to 1410. These two steps mirror the first two steps recited in claim 1. In other words, claim 1 is supported in the figure, with the understanding that Step 1407 may be skipped or performed in parallel with Step 1404. Alternately stated, the Applicant is required to present a specification and figure(s) that support the claims. However, there is no requirement that each claim be supported by a unique figure. Therefore, there are no contradictions in the figure when read in the context of the specification, in support of the claims.

With respect to claim 25, the Office Action states that the description on page 23, lines 8-19, does not enable all possibilities of annealing in response to application of two different energy densities. Page 23, ln. 8-19, states that annealing occurs as a result of summing the first energy density with an additional energy density. This explanation

clearly supports the recitation of "annealing ... in response to the first and second energy densities". It would be clear to a person skilled in the art that if the first area can be annealed using a single laser, the same area can be annealed by combining the energy densities of the laser with an additional laser or lamp source. This same analysis applies to claim 28.

With respect to claims 32 and 35, the Office Action states that there is no clear relationship expressed between when the laser or lamp is applied with respect to the laser used in the DS process. In response, it is noted that the claims recite that the laser/light is used in the same (DS) process as the second laser. Support for these claims can be found in the specification where it states that Step 1419 applies an additional energy source, either a laser beam or lamp light, to the second area, with the second laser of Step 1418 (page 26, ln. 1-24). It would be clear to a person skilled in the art that if the second area can be annealed using the second laser, the same area can be annealed by combining the second laser with an additional laser or lamp source.

CLAIMS 26-27, 29-31, 33-35, AND 36-38

Claims 26-27 have been rejected on the basis that they are dependent from claim 25. Since 25 is enabled, claims 26-27 are enabled. Claims 29-31 have been rejected on the basis that they are dependent from claim 28. Since 28 is enabled, claims 29-31 are enabled. Claims 33-35 have been rejected on the basis that they are dependent from claim 32. Since 32 is enabled, claims 33-35 are enabled. Claims 36-38 have been rejected on the basis that they are dependent from claim 35. Since 35 is enabled, claims 236-38 are enabled.

4. The rejection of claims 1, 3-21, 23, and 25-44 for failure to comply with the enablement requirement under 35 U.S.C. 112, first paragraph.

CLAIM 1

The Office Action states that there is no support for the negative limitation of "not rotating the aperture patterns". In response, the Applicant notes that original claim 2, now canceled, recited first and second aperture patterns that are orthogonal to each. These limitations are now recited in claim 1. Since claim 1 describes the lateral growth crystal grains in orthogonal directions using orthogonal aperture patterns, a person skilled in the art would understand that such a process cannot be performed if the apertures or substrate are rotated.

As noted in the amended paragraph beginning on line 10 of page 6:

> For each step in the 2N-shot process, grain boundary locations are determined by the fixed configuration of the apertures in the mask. That is, an individual aperture, corresponding to an individual grain boundary, cannot be moved without moving all the apertures (i.e., moving the mask). There may be some flexibility in the alignment of the mask for the first 2N-shot iteration in a sequence, however, there is likely a preferred alignment. To maximize use of a substrate, subsequent iterations will require aligning the mask with the boundaries from previous iterations. That is, there is little flexibility in mask alignments for subsequent iterations.

CLAIMS 3-21, 23, and 25-44

Claims 3-21, 23, and 25-44 depend from claim 1. Since there is support in the original claims and specification for the aperture

patterns remaining fixed (not rotating), claim 1 is enabled. Dependent claims 3-21, 23, and 25-44, are therefore also enabled.

4. The rejection of claims 1, 3-21, 23, 25-44, and 65-66 as unpatentable under 35 U.S.C. 103(a) with respect to Sposili et al. ("Sposili"; US 6,908,835 or WO 02/086954) in view of Yamazaki et al. ("Yamazaki"; US 5,894,137), and Fukunaga et al. ("Fukunaga"; US 2004/0142543) or Kawasaki et al. ("Kawasaki"; US 6,653,657).

CLAIMS 1 and 65

Section 8 of the Office Action states that Sposili discloses a SLS process that allegedly includes both a 2N-shot laser annealing process and a DS annealing process. The Fukunaga, Kawasaki, and Yamasaki references are introduced to address the subject of devices and catalysts. This rejection is traversed as follows.

An invention is unpatentable if the differences between it and the prior art would have been obvious at the time of the invention. As stated in MPEP § 2143, the *KSR International Co. v Teleflex Inc.* decision (82 USPQ2d 1385, 1395-1397, 2007) suggests 7 exemplary rationales to support a conclusion of obviousness, which include:

A) Combining prior art elements according to known methods to yield predictable results;

B) Simple substitution of one known element for another to obtain predictable results;

C) Use of known technique to improve similar devices (methods, or products) in the same way;

D) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;

E) "Obvious to try" – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

F) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art;

G) Some teaching, suggestion, or motivation in prior art would have lead one of ordinary skill to modify the prior art reference or the combine prior art references teachings to arrive at the claimed invention.

The Office Action states that modifications to Sposili would have been obvious to one of ordinary skill in the art in light of Yamazaki/Fukunaga/Kawasaki. This rejection appears to be most closely grounded in the G) rationale - Some teaching, suggestion, or motivation in prior art would have lead one of ordinary skill to modify the prior art reference or the combine prior art references teachings to arrive at the claimed invention.

With respect to this rationale, MPEP 2143 (G) states that the rejection must articulate the following criteria to resolve the *Graham* factual analysis:

(1) a finding that there was some teaching, suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings;

(2) a finding that there was a reasonable expectation of success; and

(3) whatever additional findings based on the Graham factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.

With respect to the above-referenced first factual analysis criteria, the Yamazaki/Fukunaga/Kawasaki references have been combined with Sposili based upon the assumption that the combination discloses every limitation recited in Applicant's claims 1 and 65. However, with respect to claim 1, none of the references disclose a 2N-shot process that is conducted without rotating either the substrate or the mask. The use of a mask with orthogonal apertures is completely unanticipated by any of the references, and results in considerable fabrication efficiencies. With respect to claims 1 and 65, none of the references disclose a DS process that is performed on selected regions of a previously annealed polycrystalline film with grain boundaries. Therefore, even if a practitioner would have been motivated to combine these references, that combination does not explicitly disclose every limitation of claims 1 and 65.

The Office Action acknowledges that Sposili discloses rotating the substrate 90° in the performance of the SLS annealing process. The Office Action appears to acknowledge that the prior art does not disclose SLS annealing performed with orthogonal apertures. Further, the Office Action fails to mention a DS annealing process performed by any of the references, or a combination of SLS and DS annealing. The limitations of 2N-shot (SLS) annealing using orthogonal

apertures, in combination with DS annealing, distinguish the claimed invention from the prior art.

The Office Action states (page 14) that there appears to be no patentable significance to "patterning orientations", as "...it is a matter of applying common sense and simple geometries to determine equivalent means of producing like configurations..." However, this assertion is a classic example of hindsight reasoning. The Examiner's argument would have been better supported if a reference had been provided of a mask or annealing process based upon the use of orthogonal slits. The use of orthogonal apertures, although simple in retrospect, has eluded practitioners for years, and is now used by Sharp in the mass production of liquid crystal display (LCD) televisions. Alternately stated, there is no evidence that a practitioner studying the Sposili reference, which discloses a mask rotation process, would come up with the idea of orthogonal apertures. Sposili clearly shows only one way of achieving orthogonality, and the concept of orthogonal slit masks was not widely known at the time of the invention.

"(A)nalysis [of whether the subject matter of a claim would have been obvious] need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1740-41, 82 USPQ2d 1385, 1396 (2007). However, if the *prima facie* rejection is supported by what was known by a person of ordinary skill in the art, then additional evidence should have been provided. Notable, when the source or motivation is not from the prior art references, "the

evidence" of motive will likely consist of an explanation or a well-known principle or problem-solving strategy to be applied". *DyStar*, 464 F.3d at 1366, 80 USPQ2d at 1649.

The Office Action does not mention a principle or problem-solving strategy that a practitioner might follow in modifying the Sposili reference, except to say that pattern orientation are a matter of common sense. The Office Action does not supply evidence that it was well known at the time of the invention to use a mask with orthogonal aperture patterns. Neither does the Office Action supply evidence that it was well known to follow a 2N-shot laser annealing process by a DS annealing process. Finally, the Office Action does not supply evidence that it was well known to selectively anneal a polycrystalline film with grain boundaries using a DS annealing process.

The Yamazaki, Fukunaga, and Kawasaki references do not address any of the claim limitations at issue. The Office Action (Sections 21-22 and 25; mailed 9/19/2006) states that it would have been obvious to apply the subsequent process techniques of Yamazaki, Fukunaga, or Kawasaki with the sequential crystallization process taught by Sposili. However, no support is given in the Office Action for this assumption. A *prima facie* case for obviousness cannot be made without an analysis of how the references can be combined or modified to make the claimed invention obvious. Fukunaga's KrF laser process does not suggest modifications to Sposili's rotation steps that make the use of orthogonal aperture pattern obvious. In fact, the combination suggests that there is no other means for orthogonally annealing. Neither does Fukunaga's laser process suggest modifications to Sposili's SLS process that make

obvious the DS annealing of selected areas of a previously laser annealed polycrystalline film. Likewise, no evidence has been provided that Yamazaki or Kawasaki suggest modifications to Sposili that would make obvious orthogonal aperture patterns, or the use of a DS process to anneal selected areas of a polycrystalline film (claim 1), with grain boundaries (claim 65).

A *prima facie* analysis of motivation is especially critical in the present circumstances since the rejection is predicated on limitations that are not explicitly disclosed in the prior art references. The claimed invention can only be obvious if an artisan makes substantial modifications to the Sposili. However, there is nothing in the Yamazaki/Fukunaga/Kawasaki references that suggests such a modification. Further, no evidence has been provided that such a modification would have been obvious based upon well known principles.

With respect to the second analysis criteria needed to support the G) obviousness rationale, even if a practitioner were given the Yamazaki/Fukunaga/Kawasaki references and combined them with Sposili, no evidence has been provided to show that there is a reasonable expectation of success in the claimed invention. That is, there can be no reasonable expectation of success if the references, and what was known by artisan at the time of the invention, do not teach or suggest all the limitations of the claimed invention.

In summary, the Applicant respectfully submits that a *prima facie* case of obvious has not been supported since the combination of

Yamazaki/Fukunaga/Kawasaki with Sposili does not explicitly disclose every limitation of claims 1 and 65. Neither has a case been supported that Sposili can be modified to supply the missing limitations in view of Yamazaki/Fukunaga/Kawasaki, or what was well known by a person of skill at the time of the invention.

CLAIMS 3-21, 23, 25-44, and 66.

Claims 3-21, 23, and 25-44, are dependent from claim 1, and 66 is dependent from claim 65. Since claims 1 and 65 can be distinguished from the cited prior art references, a *prima facie* case has not been presented to support the rejection of these dependent claims.

SUMMARY AND CONCLUSION

It is submitted that for the reasons pointed out above, the claims in the present application clearly and patentably distinguish over the cited references. Accordingly, the Examiner should be reversed and ordered to pass the case to issue.

Respectfully submitted,

Date: 11/6/2008

/Mali/
Gerald Maliszewski
Registration No. 38,054

Customer Number 55,286
P.O. Box 270829
San Diego, CA 92198-2829
Telephone: (858) 451-9950
Facsimile: (858) 451-9869
gerry@ipatentit.net

CLAIMS APPENDIX

IN THE CLAIMS:

1. (previously presented) A method for producing polycrystalline silicon, the method comprising:

forming a film of amorphous silicon;

using a 2N-shot laser irradiation process to form polycrystalline silicon in a first area of the film, where the film is exposed to a series of 2-shot laser irradiation steps, where N is greater than 1 and equal to the number of steps, and where for each step, the direction of lateral growth is rotated 90° with respect to the previous step;

selecting a second area, included in the first area;

using a directional solidification (DS) process to anneal the second area;

wherein exposing the film to a series of 2-shot laser irradiation steps includes:

in a first step, projecting a first laser beam through a first aperture pattern oriented in a first direction with respect to the film; and,

in a second step, projecting the first laser beam through a second aperture pattern oriented in a second direction, orthogonal to the first direction, without rotating the silicon film, and without rotating the aperture patterns.

2. canceled

3. (previously presented) The method of claim 1 wherein using a 2N-shot laser irradiation process to form polycrystalline silicon in a first area of the film includes forming in the first area:

a first plurality of parallel grain boundaries oriented in the first direction and having consecutive grain boundaries equally spaced by a first width; and,

a second plurality of parallel grain boundaries oriented in the second direction and having consecutive grain boundaries equally spaced by a second width.

4. (original) The method of claim 3 wherein forming first and second pluralities of grain boundaries having respective consecutive grain boundaries equally spaced by first and second widths, respectively, includes:

selecting the first width in a range of 0.1 microns (μm) to 100 μm; and,

selecting the second width in a range of 0.1 μm to 100 μm.

5. (original) The method of claim 4 wherein selecting the first and second widths in respective ranges of 0.1 μm to 100 μm includes:

selecting the first width in a range of 0.1 μm to 0.6 μm; and,

selecting the second width in a range of 0.1 μm to 0.6 μm.

6. (original) The method of claim 5 wherein selecting the first and second widths in respective ranges of 0.1 μm to 0.6 μm includes:

selecting the first width in a range of 0.3 μm to 0.6 μm; and,

selecting the second width in a range of 0.3 μm to 0.6 μm.

7. (original) The method of claim 4 wherein selecting the first and second widths in respective ranges of 0.1 μm to 100 μm includes:

selecting the first width in a range of 0.6 μm to 10 μm; and,

selecting the second width in a range of 0.6 μm to 10 μm.

8. (original) The method of claim 4 wherein selecting the first and second widths in respective ranges of 0.1 μm to 100 μm includes:

selecting the first width in a range of 10 μm to 100 μm; and,

selecting the second width in a range of 10 μm to 100 μm.

9. (original) The method of claim 3 wherein forming first and second pluralities of grain boundaries with first and second widths, respectively, includes selecting the first and second widths to be equal.

10. (previously presented) The method of claim 3 wherein N = 2.

11. (previously presented) The method of claim 3 wherein using a DS process to anneal the second area includes:

subsequent to forming polycrystalline silicon in the first area, selecting a third aperture pattern;

orienting the third aperture pattern in the first direction;

projecting a second laser beam through the third aperture pattern as follows:

advancing the third aperture pattern in the first direction;

projecting the second laser beam through the third aperture pattern; and,

sequentially annealing portions of the second area; and,

selectively removing grain boundaries in the second area.

12. (original) The method of claim 11 wherein selectively removing grain boundaries in the second area includes:

smoothing ridges formed by the first and second pluralities of grain boundaries; and,

removing grain boundaries with the exception of first plurality grain boundaries.

13. (original) The method of claim 12 wherein selecting the second area includes:

selecting a first pair of sides parallel to and located between first plurality grain boundaries; and,

selecting a second pair of sides parallel to and located between second plurality grain boundaries.

14. (previously presented) The method of claim 13 wherein selecting a first pair of sides located between first plurality grain

boundaries includes co-locating at least one first pair side on a first plurality grain boundary.

15. (previously presented) The method of claim 13 wherein selecting a first pair of sides located between first plurality grain boundaries includes selecting a first pair of sides located between consecutive grain boundaries from the first plurality of grain boundaries.

16. (previously presented) The method of claim 15 wherein selecting a first pair of sides located between consecutive first plurality grain boundaries includes co-locating at least one first pair side on a consecutive first plurality grain boundary.

17. (previously presented) The method of claim 13 wherein selecting a second pair of sides located between second plurality grain boundaries includes co-locating at least one second pair side on a second plurality grain boundary.

18. (previously presented) The method of claim 11 wherein using the 2N-shot laser irradiation process to form polycrystalline silicon in the first area of the film includes performing a final laser irradiation shot in the first direction.

19. (previously presented) The method of claim 11 wherein projecting a first laser beam through the first and second aperture patterns includes using a first excimer laser source with a

wavelength between 248 nanometers (nm) and 308 nm to supply the first laser beam; and,

wherein projecting a second laser beam through the third aperture pattern includes using a second excimer laser source with a wavelength between 248 nm and 308 nm to supply the second laser beam.

20. (previously presented) The method of claim 11 wherein projecting a first laser beam through the first and second aperture patterns includes projecting the first laser beam for a pulse duration of up to 300 nanoseconds (ns); and,

wherein projecting a second laser beam through the third aperture pattern includes projecting the second laser beam for a pulse duration of up to 300 ns.

21. (previously presented) The method of claim 20 wherein projecting a first laser beam through the first and second aperture patterns includes projecting the first laser beam for a pulse duration of up to 30 ns.

22. canceled

23. (previously presented) The method of claim 20 wherein projecting the second laser beam through the third aperture pattern includes projecting the second laser beam for a pulse duration of up to 30 ns.

24. canceled

25. (previously presented) The method of claim 3 wherein using a 2N-shot laser irradiation process to form polycrystalline silicon in a first area of the film includes:

exposing the first area to a first energy density from the first laser beam;

projecting a third laser beam, with a second energy density, onto the first area; and,

annealing the first area in response to the first and second energy densities employed on the first area.

26. (original) The method of claim 25 wherein projecting a third laser beam onto the first area includes projecting, from a solid state laser source, a third laser beam with a wavelength of 532 nm and a pulse duration of between 50 ns and 150 ns.

27. (original) The method of claim 25 wherein projecting a third laser beam onto the first area includes projecting, from a carbon dioxide (CO_2) laser source, a third laser beam with a wavelength in a range of 10.2 μm to 10.8 μm and a pulse duration of up to 4 milliseconds (ms).

28. (previously presented) The method of claim 3 wherein using a 2N-shot laser irradiation process to form polycrystalline silicon in a first area of the film includes:

exposing the first area to a fourth energy density from the first laser beam;

exposing the first area to a first lamp light having a fifth energy density; and

annealing in response to the fourth and fifth energy densities employed on the first area.

29. (original) The method of claim 28 wherein exposing the first area to a first lamp light includes exposing the first area to light from an excimer lamp with a wavelength less than 550 nm.

30. (previously presented) The method of claim 28 wherein exposing the first area to a first lamp light includes exposing the substrate underlying a first bottom surface of the amorphous silicon film first area.

31. (previously presented) The method of claim 28 wherein exposing the first area to a first lamp light includes exposing a first top surface of the amorphous silicon film first area.

32. (previously presented) The method of claim 11 wherein projecting a second laser beam to anneal the second area includes:

exposing the second area to a seventh energy density from the second laser beam;

projecting a fourth laser beam onto the second area having an eighth energy density; and,

annealing portions of the second area in response to the seventh and eighth energy densities employed on the second area.

33. (original) The method of claim 32 wherein projecting a fourth laser beam onto the second area includes projecting, from a solid state laser source, a fourth laser beam with a wavelength of 532 nm and a pulse duration of between 50 ns and 150 ns.

34. (original) The method of claim 32 wherein projecting a fourth laser beam onto the second area includes projecting, from a CO_2 laser source, a third laser beam with a wavelength in a range of 10.2 μm to 10.8 μm and a pulse duration of up to 4 ms.

35. (previously presented) The method of claim 11 wherein projecting a second laser beam to anneal the second area includes:

exposing the second area to a tenth energy density from the second laser beam;

exposing the second area to a second lamp light having an eleventh energy density; and

annealing portions of the second area in response to the tenth and eleventh energy densities employed on the second area.

36. (original) The method of claim 35 wherein exposing the second area to a second lamp light includes exposing the second area to light from an excimer lamp with a wavelength less than 550 nm.

37. (previously presented) The method of claim 35 wherein exposing the second area to a second lamp light includes exposing

the substrate underlying a bottom surface of the amorphous silicon film second area.

38. (previously presented) The method of claim 35 wherein exposing the second area to a second lamp light includes exposing a top surface of the amorphous silicon film second area.

39. (previously presented) The method of claim 11 further comprising:

forming a transparent substrate;

forming a diffusion barrier overlying the substrate and underlying a portion of the film of the amorphous silicon defined by the first area;

the method further comprising:

subsequent to annealing the second area, forming in the second area, a transistor channel region with a length oriented in the first direction, and a width;

forming in the first area, source and drain regions adjacent to, and interposing the transistor channel region;

forming a gate dielectric layer overlying the transistor channel, source, and drain regions, the dielectric thickness in a range of 20 angstroms (A) to 500 A over the channel region; and,

forming a gate electrode overlying the gate dielectric layer.

40. (previously presented) The method of claim 39 wherein forming a channel region with a length includes forming the

channel length with a first pair of sides parallel to and located between a pair of grain boundaries from the first plurality grain boundaries; and,

wherein forming a channel region with a width includes forming the channel width with a second pair of sides parallel to and located between a pair of grain boundaries from the second plurality grain boundaries.

41. (previously presented) The method of claim 40 wherein forming the channel length with a first pair of parallel sides includes co-locating at least one side from the first pair on one of the grain boundaries from the first plurality of grain boundaries.

42. (previously presented) The method of claim 40 wherein forming the channel length with a first pair of parallel sides includes forming the channel length with a first pair of parallel sides located between a pair of consecutive grain boundaries from the first plurality of grain boundaries.

43. (previously presented) The method of claim 42 wherein forming the channel length with a first pair of parallel sides includes co-locating at least one side from the first pair on one of the grain boundaries from the first plurality of grain boundaries.

44. (previously presented) The method of claim 40 wherein forming the channel width with a second pair of parallel sides includes co-locating at least one side from the second pair on one of the grain boundaries from the second plurality of grain boundaries.

45-64. canceled

65. (previously presented) A method for laterally growing crystal grains in predetermined areas of a previously annealed silicon film, the method comprising:

in a first area of a silicon film, forming polycrystalline silicon having a plurality of parallel grain boundaries oriented in the first direction, and a plurality of parallel boundaries oriented in the second direction, orthogonal to the first direction;

using a directional solidification (DS) annealing process, sequentially annealing a second area defined by a pair of grain boundaries oriented in the first direction, intersecting a pair of grain boundaries oriented in the second direction; and,

in response to the DS annealing, laterally growing crystal grains in the second area.

66. (previously presented) The method of claim 65 wherein sequentially annealing the second area includes sequentially annealing the second area in the first direction; and,

wherein laterally growing crystal grains includes laterally growing crystal grains across grain boundaries previously defined in the second direction.

EVIDENCE APPENDIX

NONE

RELATED PROCEEDINGS APPENDIX

NONE